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LONG-TERM GOALS

The central efforts are to conduct research in ocean acoustics and signal processing, educate graduate students and participate in the ONR research community.

OBJECTIVES

Conduct long term basic research in ocean acoustics, with emphasis on involving graduate students, post docs and junior researchers in the research. Concerning graduate students, goals include both exploring research ideas that may lead to thesis research and the thesis research itself. Another important objective is to establish a scale model acoustic facility that can be used for research and training. A further objective is to periodically interact with ONR personnel on issues concerning their research community.

APPROACH

This grant has been supporting both pre and post qualifying graduate students as well as post docs. Further, a scale model research facility that has been constructed has now been used for experiments related to shallow water propagation, detection of objects on the bottom and underwater acoustics communications have been conducted.

WORK COMPLETED

The laboratory facility is now up and running and experiments have been performed that demonstrate how modes can be isolated on non-watercolumn spanning arrays. This lab work was then used to work out algorithms that were successfully applied to data.

A second research area I pursued was using ocean microseisms for inversion.

One of the graduate students supported on this grant (first item in paragraph above) finished his Ph. D. Two other graduate student are being supported on this grant—one working on robust signal processing and the other on adjoint methods applied to inversion. A Post Doc is also being supported who is working on time reversal focusing beyond the diffraction limit. This grant also provides me

with the freedom to be involved in an assortment of ocean and Navy related activities as a member of the National Academy of Engineering.

RESULTS

A very important result is that our grad students, supporting by this program are moving forward in their research studies and research. One student, completely supported by the grant has finished his Ph. D. involving the development of a procedure to extract modes in shallow water from moving sources (even with nonuniform motion) of opportunity – but without using a water-column-spanning array or model calculations (Grad student-Shane Walker). Figure 1 shows an example of a smeared out wavenumber pattern where frequency corresponds to the Doppler shift. The continuous curve is a result of irregular motion but the Doppler correction optimization procedure shows the discrete spectrum.

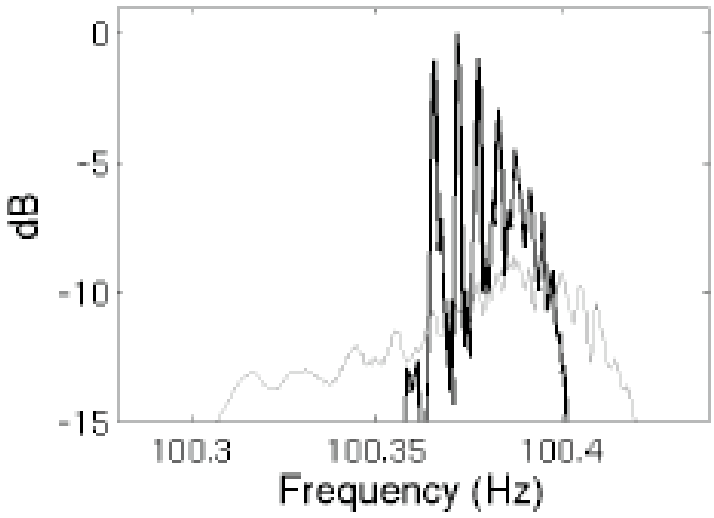

Figure 1. Doppler smearing of wavenumber spectrum corrected by optimization procedure.

Another student, Jit Sakar has been studying the adjoint method for describing the acoustic field sensitivity to environmental uncertainty. Figure 2 shows an example in which environmental uncertainty is expressed in terms of correlated noise that in turn shows up as a beamformer degradation.

As a SecNav chair, I also was involved in meetings with Admiral Waikwicz, C. O. of the San Diego ASW Center in which an assortment of environmental and processing issue were discussed. Further, during this year, I have had meetings with all levels of ONR managements on various ONR and research community issues.

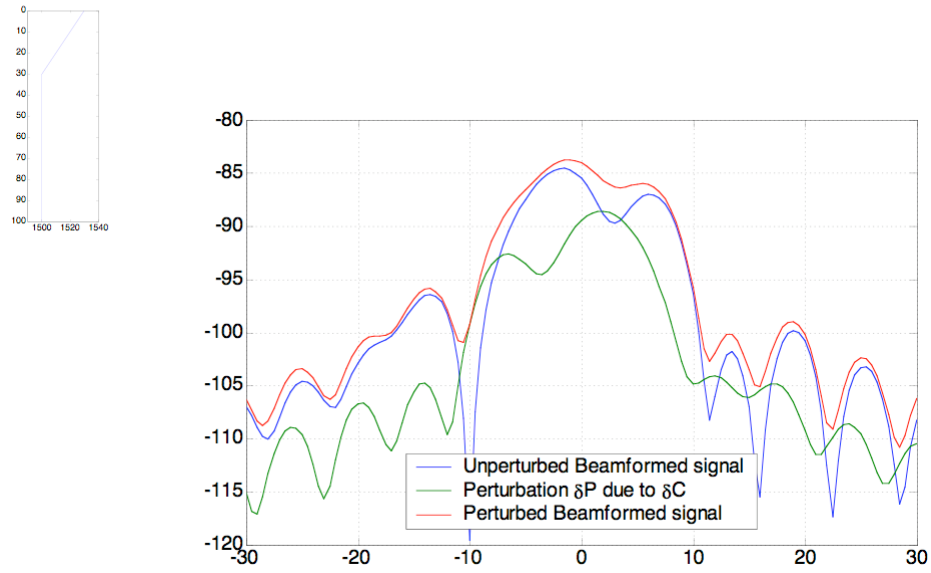

Figure 2. Environmental uncertainty degrades expected beamformer.performance.

Figure 2 shows the modal extraction results and Figure 3 is an ongoing research example of results for studying reverberation in a waveguide that was motivated by data taken at sea.. Figure 4 shows the lab setup for studying an MCM problem in which iterative time reversal was used.

PUBLICATIONS

S. C. Walker, P. Roux, and W. A. Kuperman, "Data-based mode extraction with a partial water column spanning array," J. Acoust. Soc. Am. **118** (3), 1341-1347 (2005).

S. C. Walker, P. Roux, and W. A. Kuperman, "Focal depth shifting of a time reversal mirror in a range-independent waveguide," J. Acoust. Soc. Am **118** (3), 1518-1525 (2005).

S. C. Walker, P. Roux, and W. A. Kuperman, "Mode extraction from an accelerating narrowband source in shallow water," J. Acoust. Soc. Am., submitted for publication August 2005.